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A METHOD FOR IDENTIFYING AND PREVENTING REPETITIVE STRAIN INJURY

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A method for identifying and preventing Repetitive Strain Injury

Abstract

Repetitive strain injury represents an important burden arising from work-related activities, generating considerable societal and employer costs through workers' compensation claims. The method presented in this disclosure offers a way that aims to help identify and prevent such medical condition by collecting usage data from mouse and keyboard strokes throughout the day. With the collected information, it is possible to apply algorithms and techniques to predict trends of usage and check against company's policies and guidelines to help the user to take breaks or reduce the intensity of the tasks.

I. Introduction

Repetitive strain injury (RSI) and cumulative trauma disorder (CTD) are two of several terms used to describe a group of activity-related soft-tissue injuries that include tendonitis, forearm myalgia, and nerve entrapment syndromes, among other conditions. RSIs and CTDs represent an important burden arising from both sport [1] and work-related [2] activity, the latter generating considerable societal and employer costs through workers' compensation claims. According to [3], working with a computer for more than 6 hours per day was associated with high rates of RSI in all body regions.

While computer and technology can be responsible for those medical conditions, they can also be used to help prevent and mitigate such disorders. The idea from this disclosure proposal is to collect relevant data related to the computer usage, such as mouse movements and clicks, keyboard strokes and their duration, for example, to apply machine learning techniques to identify patterns and provide recommendations. By doing this collection, we will be creating an important dataset that can be used by individuals to enhance their posture and computer usage but also allows companies to better understand their employees.

II. Method

The overall idea behind the proposed method is quite simple: using existent software applications to periodically collect data that is relevant to identify RSI occurrences. The data collected from the different assets (computers, laptops and similar) will be correlated and associated to the user that interacts with it. Based upon this correlation, the proposed method will be able to understand the amount of time and computer usage that is associated with that particular user and provide recommendations regarding posture, and suggestion for breaks in a form of feedback.

The data to be collected is related to the hardware usage: typically, a keyboard(s) and mouse(s). This collection should be performed in a time-series way - meaning that the system should be able to associate a timeframe to the usage, so it is possible to obtain statistical information regarding the mouse movement per hour or the number of keyboard strokes per minute. This is the base of information for not only using existent machine learning algorithms but also to create a complex and comprehensive database on RSI occurrences.

i. Mouse Clicks

When the mouse moves around the available screens, it navigates in a wide range of coordinates (x, y) axis. The proposed method considers saving those coordinates along with the time when it occurred. This data collection will allow us to understand, in a very complete way, how much time the user spent using the mouse throughout the day.

Having also the understanding of each monitor, we can also co-relate the mouse coordinates with the monitor size and resolution. Such information will allow the proposed method to infer an approximate distance done by the mouse, in a specific timeframe.

Based on such coordinates and using simple machine learning algorithms, it is possible to identify repetitions on the movements. Needless to say, the more the mouse moves, using the same range of coordinates, more repetitive seems to be the task executed.

ii. Keyboard Strokes

Keyboard usage is another important factor to be considered. Not the kind of content that is typed, per say, but the number of keyboard keys that are pressed. Like the mouse movements, the proposed method suggests that the keyboard key usages are associated with a timestamp. This will allow the application to obtain the statistical usage of the keyboard, so it can proceed with the previously mentioned recommendations.

If the application is capable to collect the pressed keys along with the number of occurrences, it will also allow the proposed method to identify patterns, using existent machine learning algorithms. Based on this detailed understanding, the method will be able to identify excessive usage and proceed with recommendations.

iii. Monitor

Based on [4], when the monitor is placed in the wrong position it can force the operator to work in a variety of awkward positions. Such forced working body positions significantly contribute to the operator's discomfort and can potentially lead to work-related musculoskeletal injury (WMSD). There are guidelines and common recommendations on how to arrange the monitor related to the user positioning - but they differ from one another. Although there isn't a *final and absolute* rule, there are recommendations that should be followed.

The proposed disclosure suggests that the computer camera, when available, can help to understand and offer recommendations in this regard. Our application can be periodically activated to collect a sample image and, using an existent algorithm, infer the user distance from the monitor (camera). Based on this information and following the literature recommendations[4], we can provide insights into the user posture, based on the collected information.

iv. Recommendations

There are multiple recommendations that are associated to help prevent RSI occurrences. Most of them include taking regular breaks. The discussion from [5] illustrates the importance of taking regular breaks during a work cycle, to prevent such medical conditions.

The proposed method focuses on collecting data and processing it in such a way that it can be used to help, as a suggestion mechanism, on when an RSI scenario might happen. At the same time, it can be used as an output mechanism to raise policies that are pre-defined by the company guidelines. This means that based on the company guide- lines, when the proposed method identifies an RSI-like scenario, it can proceed with the recommendation.

For the sake of exemplification, the recommendation can range from a simple message pop up on the user screen, e-mail notification to the employee direct manager or the complete workstation lock for a given amount of time.

v. Time vs. Intensity

Although there doesn't appear to be good scientific studies that can correlate the number of keystrokes per minute with RSI exposure measurement, there is, indeed, evidence that point toward this direction. The study from

[6] and [7] shows indications that *"very high numbers of keystrokes and very high keystroke rates, at levels above 10,000 keystrokes per hour, may cause an increased risk"*. This is an important factor that the method proposed by this disclosure takes into consideration.

vi. Act Upon Data

The method proposed by this disclosure takes into consideration different inputs: mouse movements, keyboard strokes (and associate rates), eye (and body) position based on camera image analysis. Based on these individual measurements, one can apply machine learning algorithms to help predict the subsequent usage rates. Based on the prediction rates, we can check it against a predefined (and customizable) thresholds: if a threshold is met, a recommended action is suggested, because it is likely that an RSI might occur.

III. Discussion

The proposed data collection method can be implemented as a background service application, running on user devices. The outcome of this data collection and analysis offers both a mechanical and humane understanding, for companies and individuals.

From a pure productivity perspective: the company will have ways to understand the amount of time and intensity of the company resource assets usage, by the employees. From a humane, perspective, it will allow the managers to identify potential early stages of fatigue and symptoms that can lead to RSI or even more serious diseases. Having such data, the company can act accordingly in order to prevent issues. From a user perspective, the system will help them to protect their health in a transparent way. Sometimes, computer users can get very focused on the tasks and forget to take occasional breaks; by having the proposed method in place, everyone will automatically benefit from the recommendations that the tool can provide.

While the proposed method brings value both to the company and to the end-user, it will also allow the creation of an important dataset. Nowadays, information is the base for everything: just like we are already collecting multiple data, from a wide range of hardware and sensors, we might as well collect the actual iterations that a user is doing and benefit from it.

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